Notes on the Biology of Scatopse fuscipes (Meigen) (Diptera: Scatopsidae)

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Introduction

The scatopsids are a small, economically unimportant family of Diptera. One species (*Scatopse fuscipes*) is occasionally a nuisance around canneries and wineries since it can develop large populations in very small amounts of decaying organic matter. This insect is easily reared under laboratory conditions. This quality, in addition to its relatively short life cycle, makes it ideal as a potential subject for ecological studies. An exhaustive search of the literature revealed that very little information is available on the biology of any of the scatopsids. This work is undertaken with the hope of supplying some of this basic knowledge, which will facilitate more extensive investigations.

Materials

The flies used in these experiments were from a culture reared in the laboratory for 3 years. They were fed on CSMA fly medium,[2] saturated with water, and allowed to ferment for 12 hours. The medium is placed in petri dishes or in 1 pint wide-mouthed jars in the fly cage, and kept quite moist. New medium is introduced as needed. Except when otherwise specified, the flies were reared at room temperatures and not under any precisely controlled conditions. Room temperatures in the laboratory varied from 75° to 80° F. with little or no variation between night and day temperatures. The cages used were 18″ × 12″ × 10″, of wood construction with a glass top, and with two small, sleeved openings for ready access.

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[2] The medium used here is the dry mixture prepared by the Ralston-Purina Company, St. Louis, Missouri and consists of 2 parts of soft wheat bran (coarse) and one part of alfalfa meal.

Adults

Mating behavior. The flies appear to be sexually mature on emergence, since copulation sometimes occurs when the adults are only 30 minutes old. Large numbers of mating pairs may be seen concentrated under petri dishes and in the corners of the cages. This concentration may be due to a negative response to light or to positive thigmotropism. Adults copulate for considerable periods and separate for varying periods, sometimes changing mates. An adult, presumably male, may try to separate a copulating pair presumably with a view to finding a mate. The adult stage seems to be devoted exclusively to reproduction and food is not consumed. If provided with a moist substrate, most females will oviposit.

Oviposition. Female *S. fucipes* oviposit 24 to 30 hours after emergence, and die shortly after oviposition. Most males live 30 to 45 hours.

Oviposition site. The following tests were made to determine the suitability of various sites for oviposition. A number of copulating pairs of flies were placed in two sets of three petri dishes each, one containing food resting on moist filter paper, another with moist filter paper and no food, and the third with only dry filter paper. After a few days, the dishes were carefully examined. The results (Table 1) show that the flies do not oviposit on dry surfaces. Eggs were found in all dishes except those containing dry filter paper. Some females from the latter group had strands of up to 30 eggs protruding from the genitalia. This suggests that, in the absence of moisture, oviposition may be initiated but cannot be completed. Dark areas, e.g., spots, or bits of food on filter paper, were always preferred sites for egg-laying.

Table 1.—Comparison of Several Sites for Oviposition

	Egg Masses	Females having Oviposited	Females still Gravid
Food	11*	12	1
Dry paper	0	0	12
Moist paper	8*	9	3

* Eggs laid by 1 female were apparently concealed and could not be found.

The egg mass. The eggs are released from the female in a long strand, each egg being attached at the ends to the preceding and succeeding ones, and this strand is folded lengthwise into a mass. The mass does not lie flat on the substrate, but is somewhat crescent shaped, so that the eggs appear to be pointed upwards. The eggs are arranged in rows, about six rows constituting the length of the mass. Ten egg masses were measured and the lengths ranged from 1.2 to 1.7 mm. and averaged 1.3 mm. The widest part of an egg mass occurs in the middle, while the ends taper gently. The width consists of about six eggs lying side by side. Shortly after oviposition the apical attachments of the eggs are broken. Occasionally an incomplete egg mass is seen, in which the eggs spread over a wider area, and are irregularly arranged.

The oviposition process. A gravid fly was placed on its back on moist filter paper and its abdomen pressed gently for a few seconds. Observation under a binocular microscope showed peristaltic movements in the segments close to the genitalia, and at each contraction an egg was released. The eggs came out in a long strand which soon formed a cluster. After about fifty eggs had been released, the rate of contraction was timed. For the next four minutes, the rate of contraction was 29, 28, 27, and 26 per minute, respectively. During the fifth minute the release of eggs ceased, but peristalsis continued for two minutes longer, the rate decreasing rapidly. The fly remained inactive and died after 90 minutes. On dissection, seven eggs were found in the ovary. Subsequent attempts to induce oviposition in other females were not successful.

Eggs

The eggs in the mass may be separated by placing them in 1% sodium hypochlorite. In a few minutes, complete separation is achieved and they may be easily counted. On January 10, five egg masses were counted. The number of eggs per mass ranged from 135 to 215, with an average of 189. On March 28, ten egg masses produced an average of 257 eggs per mass and ranged from 174 to 320. The difference in the egg production

of the two groups may have resulted from differences in food consumption during the larval stages.

Effect of temperature on incubation of eggs. The effect of temperature on incubation was studied by placing egg masses in hanging drops and exposing them to different temperatures until hatching. The results (Table 2) show that the lower threshold for hatching lies between 5° and 10° C. At the former temperature, no hatching occurred, while at the latter, hatching occurred in 16 days. Between 10° and 30° C., there was an inverse relationship between temperature and incubation period. At the temperatures: 10°, 15°, 20°, 25°, 30°, and 35° C. eggs hatched in 16 days, 189–206 hours, 120 hours, 72 hours, 47 hours, and 45–49 hours, respectively. The test failed to show any appreciable difference in hatching time at 30° and 35° C. We may reasonably assume that the upper threshold for hatching is a little above 35° C.

TABLE 2.—Effect of Temperature on Incubation of Eggs

Temperature	Rep. 1	Rep. 2	Rep. 3
5° C.	—*	—*	
10° C.	16 days		
15° C.	189–206 hrs.	189–206 hrs.	
20° C.	120 hrs.	126½ hrs.	
25° C.	72 hrs.	76–79 hrs.	72 hrs.
30° C.	47 hrs.	42–54 hrs.	
35° C.	41–49 hrs.	45½–49½ hrs.	

* No hatching occurred.

LARVAE

Duration of larval stage. One egg mass was placed in each of four dishes supplied with large amounts of CSMA fly medium. The duration from the hatching of eggs to pupation was noted. The data (Table 3) show that in the first dish the larval stage lasted from 12 to 15 days, in the second dish from 11 to 15 days, in the third dish, from 12 to 14 days, and in the fourth dish from 13 to 18 days.

Effect of inadequate food supply on larval growth. Egg masses were placed in four dishes which contained very limited

amounts of food. The eggs hatched on schedule, but during the next 49 days no pupae appeared in any of the dishes. Three dishes were then discarded and the fourth observed closely for an additional four months. Still no pupae had appeared, although the larvae remained active. Thus the larval period was extended to nearly seven months.

To determine whether food shortage accounted for the failure of the insects to pupate, the larvae from one of the discarded dishes were transferred to a chamber with adequate food. Four days later the first pupa was formed. Within 17 days, 49 insects had completed the larval stage. These findings indicate that the scatopsid larvae had a tremendous ability to withstand adverse conditions. Poor food supply can seriously retard larval growth, but can also prolong larval life.

Number of larval instars. The number of larval instars may be determined by counting the number of larval skins shed by an insect. In this experiment, the food medium was allowed to ferment, then it was filtered. Newly emerged larvae were reared on the filtrate and the number of molts recorded. Of the 23 insects which completed the larval stages, 17 underwent three molts each, while each of the remaining six were observed to molt twice. It is believed that on each of these six occasions, one molt was overlooked. Hence, we may conclude that the Scatopsid has four larval instars.

TABLE 3.—Duration of Larval Stage

Days after Hatching	Number of Pupae Appearing			
	Rep. 1	Rep. 2	Rep. 3	Rep. 4
11		6		
12	13	15	3	
13	8	11	2	7
14	3	5	1	6
15	1	2		12
16				28
17				7
18				5

Pupa

Duration of pupal stage. Pupae were placed on moist filter paper in vials, as soon as they were formed. Notes were made of the time required to complete the pupal stage. Three tests were conducted on different dates. In each test, the adult females emerged earlier than the males. However, the results for any given sex varied from one test to another. This is probably due to differences in room temperature at the time when the different experiments were performed. The duration of the pupal stage in 14 males ranged from 96 to 139 hours with a mean of 109.4 hours, while that of 11 females ranged from 86 to 126 hours with a mean of 97.6 hours.

Abstract

The life cycle of *Scatopse fuscipes* is completed in about 20½ days at room temperature. The approximate duration of the egg, larval, pupal, and adult stages are 3, 12, 4, and 1½ days, respectively. The females have shorter adult and pupal stages than the males. Within certain limits there is an inverse relationship between temperature and the incubation period of eggs. The larval stage may be prolonged if food supply is inadequate. Larvae have been known to survive for nearly 7 months under these adverse conditions. There are probably 4 instars.

Adults copulate as early as ½ hour after emergence from the pupae, and oviposit in 24 to 30 hours. Death occurs shortly after eggs are laid. Oviposition may be initiated in the absence of moisture, but cannot be completed under those conditions. Eggs are released by the female in a long strand which is folded into a cluster. The number of eggs laid by individual females ranges from 172 to 320.

Adults react negatively to light.